

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

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ADVANCED CARBON MEASUREMENTS FOR TERRESTRIAL MEASUREMENT, MITIGATION, AND VERIFICATION

Background

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The key to any market-based carbon trading program is the ability to accurately account for carbon concentrations and inventories. For terrestrial sequestration, this requires measuring carbon stored below ground in soils and above ground in herbaceous plants and trees at scales from plots to ecosystems in size. Field data are required to support carbon accounting, to measure and verify carbon stocks, mitigate potential losses, and to validate models of the carbon cycle for terrestrial systems. In order to collect data to support carbon measurement, mitigation, and verification (MMV), new methods of carbon analysis in soils have been developed, tested, and are now being commercialized to provide rapid and cost-effective measurement technologies. The Advanced Carbon Measurements project (ACM) is advancing cutting edge science and technology that will help to reduce greenhouse gas (GHG) emissions, to improve the productivity and sustainability of soils, and to establish the scientific credibility required for a viable carbon accounting system.

Project Goals

The ACM project represents the second phase of an applied terrestrial sequestration project being conducted at Los Alamos National Laboratory (LANL). The ACM project has two primary goals. The first project goal is to advance carbon measurement technology by using new methods to measure soil carbon and to be able to distinguish between organic and inorganic carbon. Meeting this goal will include deployment and commercialization of technologies such as the laser-induced breakdown spectroscopy (LIBS) soil carbon analyzer; application of remote sensing data and intelligent image analysis software to refine sampling plans; and development of a new analytical platform to measure small fluxes in carbon above and throughout terrestrial ecosystems. A second goal is to develop reclamation methods that increase carbon sequestration rates by enhancing native plant growth/productivity, improve soil quality, and increase restoration success on western mine sites and other degraded lands.



Greenhouse study using degraded mineland soil.



Portable LIBS prototype.



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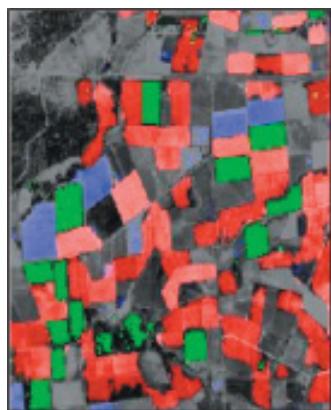
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GENIE identification of soybean (green), rice (red), and corn (blue) fields.

Phase I was designed to demonstrate that new instrumentation was effective for improved carbon measurement in soils and to evaluate carbon sequestration processes.

Phase I Accomplishments include:

- Designed and fabricated two field-portable LIBS units with multi-element analysis capability.
- Provided support to USDA-NRCS funded effort to develop sampling protocol for LIBS
- Bench-tested and calibrated LIBS with over 1,000 soil samples.
- Tested field-deployable LIBS at three sites.
- Demonstrated that soil microbes are sensitive, practical biological indicators of small seasonal changes in soil carbon concentrations.
- Developed and tested methodology for improving revegetation and stabilization of reclaimed semiarid mine lands.
- Attracted interest from the private sector for LIBS commercialization and licensing of microbial technology.
- Improved understanding of carbon sequestration processes for carbon management and modeling efforts.

Phase II of the ACM project is designed to evaluate additional carbon analysis methods to improve measurement capability, and to move mature technologies into commercial use. Phase II efforts will begin in FY 2006.

ACM Phase II Activities include:

- Commercialize bench-top and person-portable LIBS prototypes.
- Evaluate new analysis methods as potential tools to further increase the available capabilities to measure, mitigate leakage, and verify carbon in different systems.
- Demonstrate best reclamation practices for western mine lands to enhance carbon sequestration.
- Conduct field applications of MMV technologies at mine sites and degraded lands.
- Develop technology for bulk density measurement that couples with advanced measurement systems.
- Demonstrate machine-learning image processing tool (GENIE) for land-cover classification and extrapolation of ground sampling results to large land areas.
- Conduct field demonstrations and comparisons of advanced MMV technology in terrestrial systems in collaboration with USDA Natural Resource Conservation Service.
- Increase analytical sensitivity, measurement accuracy, and precision of carbon measurement technologies.
- Validate an integrated suite of technologies to measure, mitigate leakage, assess, and manage terrestrial carbon inventories.

Benefits

The President set a goal to reduce by 18% the amount of CO₂ emitted per dollar of gross domestic product (GDP) before 2012. Terrestrial sequestration of CO₂ is an immediate, low-cost, and effective method to contribute to achieving the 2012 reduction goal. However, the reduction goal of 18% can only be achieved if we use effective measurement and analysis tools to verify carbon concentrations cost-effectively in a variety of environments. The ACM project will help provide these tools. Additional benefits of the ACM project will be to demonstrate the importance of returning degraded lands to production through improved land use management to optimize the soil carbon cycle.